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Using the Perfect Step Method to Improve Odds of Ambulation After Spinal Cord Injury

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Apply It!

From this article, the reader should:

- Recognize the emergence of chronic exercise care programs for persons with spinal cord injuries.
- Gain an understanding of the overall application of the Perfect Step recovery model for SCI rehabilitation using FMA, the STEP Method, and PNAR.
- Appreciate the typical training protocol for Perfect Step clients.
- Comprehend the vast benefits of exercise therapy in the rehabilitation of people with SCI.

Key words: Spinal Cord Injury, Post Rehabilitation Exercise, Quality of Life, Functional Movement, Range of Motion

INTRODUCTION

The National Spinal Cord Injury Statistical Center estimates that there are currently around 294,000 people living with a spinal cord injury (SCI) in the United States. In addition, there are approximately 17,810 new injuries each year. Since 2015, the sex of 78% of patients was male at the time of the injury and most lesions arose between cervical levels 5 and 6 of the spinal cord. They are most often caused by vehicular crashes, followed closely by falls, and then acts of violence and sports (1). After an SCI, patients deal with short- and long-term complications.

Spinal cord injury is not only physically and psychologically taxing but also extremely expensive (1). In 2019, it was estimated that a person who sustains an SCI classified as high tetraplegic at age 25 will have to spend around 5.1 million dollars in their lifetime to address their injury. This does not include losses in wages, benefits, and productivity, which is often estimated at around $77,700 per year (1). These 5.1 million dollars represent not only the $1.1 million in initial hospital stays, surgeries, and rehabilitation within the first year of injury, but also the estimate of at least $200,000 each subsequent year to address secondary complications that commonly arise after SCI. These include bladder and bowel complications, pressure ulcers, orthostatic hypotension, fractures, deep vein thrombosis, spasticity, depressive disorders, and pulmonary and cardiovascular problems (2). An interdisciplinary approach is vital to successful medical treatment of SCI because many of these secondary complications can be combated by activity-based therapy (ABT) such as those happening at The Perfect Step (TPS) postacute paralysis recovery center in Pomona, CA. However, these therapies are often not well covered by insurance because of their postacute and supposedly exorbitant nature.

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Spinal cord injury is not only physically and psychologically taxing but also extremely expensive (1). In 2019, it was estimated that a person who sustains an SCI classified as high tetraplegic at age 25 will have to spend around 5.1 million dollars in their lifetime to address their injury.

Aside from the sheer economic cost of SCI, one of the most important and difficult factors to account for during the rehabilitation process is time (3). Physicians, surgeons, and even physical therapists spend little time with any patient because of their workload. Once a patient with an SCI moves from acute care to a rehabilitation hospital or facility, they receive higher quality care for the short term and gain pertinent information and skills to complete activities for daily living (ADLs), which improve independence. According to a study first published in 2016 by Turner-Stokes et al., specialist rehabilitation can be highly cost-effective when analyzing the long-term cost of care for patients with all neurological conditions. These locations are often more expensive up front but produce substantial savings in ongoing health-care costs, especially of high-dependency patients such as those who sustain SCI (3). However, ambulation and full independence are not often considered attainable or reasonable after a high-level SCI, especially in the eyes of insurance providers worried about the initial costs without considering the individual patient's needs or the long-term effects of the patient's condition.

Additional time constraints due to insurance coverage can further disrupt the standard of care for rehabilitation of patients with SCI. Rehabilitation hospitals are bound to insurance-based restrictions, which often terminate care before a patient can attain their highest goals after injury, especially ambulation. Centers such as TPS provide a vital postacute rehabilitation option with state-of-the-art facilities and scientifically based methodologies. Moreover, TPS focuses enormous efforts on fundraising to allow their clients to work at their center for 6 or 12 months free of charge. Their center has successfully seen at least one third of their clients get out of a wheelchair after being told they would never be able to walk again. This article will highlight some of the current modalities and exercise therapies being used at TPS and centers like it for recovery from chronic (postacute) SCI of any severity or type.

According to the American Spinal Injury Association (ASIA), spinal cord injuries can be classified by the location, types of sensory and motor loss, and the nature of the injury, complete or incomplete (4). The ASIA Impairment Scale (AIS) uses the international standards for neurological classifications of SCI (ISNCSCI) to assess the extent of an SCI by completing light touch and sharp/dull discrimination sensory exams, motor exams, and rectal exams (4). The AIS grades are A–E ranging from complete injuries with no sensation or movement to sensory or motor incomplete/complete to normal. If an incomplete injury is observed, further assessment of the dermatome and myotome affected can be done to pinpoint the level and location of the SCI (4). This score can be important when developing rehabilitation goals for patients with SCI and could be used to assess a patient's progress over time.

Unfortunately, classifications are not well communicated and tracked consistently because of the incomplete records that the nature of rehabilitation perpetuates. One of the most important factors of successful rehabilitation is the customization to the client with their individual abilities, goals, and presentations each day. This complicates methodologies for research as it makes completing randomized control trials (RCTs) nearly impossible, making all data somewhat confounded. A literature review in 2011 concluded that although there is growing consensus of strong evidence of ABT improving independent living and physiological health in patients with chronic SCI, most published studies are surveys of questionnaire-based information (5). As a result, exercise therapy is an often overlooked yet extremely important part of promoting healing and regaining function after SCI. This article demonstrates research methodologies developed at TPS that warrant further investigation and aims to suggest ways to further research in rehabilitation for patients with SCI in ethical, effective, and scientific manners.

THE PERFECT STEP

TPS is an exercise-based paralysis recovery center in Pomona, CA, modeled after ABT described by Dr. William Lucas in 2023 as "a new mode of therapy that is total body, incremental, and long-term." This methodology cultivated at TPS was conceived at the original Project Walk in Carlsbad, CA, using the philosophy of the Dardinski Method to implement ABT as a more holistic approach to rehabilitation after SCI (6).

TPS addresses a dire need for long-term rehabilitation for persons with neurologic disorders (SCI, TBI, stroke, ALS, Parkinson's, MS, cerebral palsy, transverse myelitis, spina bifida, and others). Fundamentally, TPS functions as a postacute rehabilitation center where therapy is conducted by certified paralysis recovery specialists, serving clients for months or even years after the onset of their condition (7).

TPS has created one of the most comprehensive certifications for trainers ever conceived in the industry. People with personal training experience can become paralysis recovery specialists by traveling to TPS and taking their specialized certification course. This course provides strong didactic learning and requires the completion of months of clinical internship hours to learn how to think creatively to actively work below the level of injury of a patient with an SCI. TPS drives home their motto of doing "whatever it takes to help people with paralysis regain their independence and personal confidence in who they are." It forces trainers to think outside the box about ways to modify able bodied exercises to the ability that an individual presents with to have fun and productive sessions to make progress in their recovery (7). Furthermore, paralysis recovery specialists

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at TPS and similar specialized SCI rehabilitation centers can work more directly and effectively on patient needs without pressure to complete insurance mandated exercises or tests that may be inappropriate or unnecessary for the patient. Time spent with specialists is tailored to fit patient needs rather than insurance regimens, and specialists are free to develop programs based on client goals.

This course provides strong didactic learning and requires the completion of months of clinical internship hours to learn how to think creatively to actively work below the level of injury of a patient with an SCI. The Perfect Step drives home their motto of doing "whatever it takes to help people with paralysis regain their independence and personal confidence in who they are" (7).

A TYPICAL SESSION

After assessing clients using a specific neurological Functional Movement Assessment (FMA) as demonstrated in Figure 1, TPS develops a personalized program using a Special Techniques and Exercises for Paralysis or STEP Method. The STEP Method specially considers the type and severity of SCI and a patient's medical and exercise history to generate the best program possible to reach their goals. The STEP Method also specifically addresses concerns that cause secondary complications for patients with SCI such as spasticity by utilizing patterned neural activity recruitment (PNAR) techniques. PNAR uses a variety of modalities to enhance the ability of muscles to work in specific planes of motion. A STEP Method session typically lasts for 2 hours or longer (Figure 2).

Figure 1. Perfect Step Specialist delivering range of motion, compression, and anti-gravity movements as part of the initial Functional Movement Assessment phase of each workout session. Photo courtesy of The Perfect Step.

Sessions begin with a functional movement session, which may last 60 minutes or more depending on client needs and goals, which can change depending on how the client's body presents each day. This functional movement session can be considered a type of warm-up in which patients work on specific ranges of motion either under their own power or with the assistance of a specialist. Part of this portion of the session looks at any type of pushing activity against gravity or the specialist's body to execute movements in anatomical planes that the client is not used to performing. This level of intrinsic work is completed within the initial 30 to 45 minutes of this portion of the session with direct one-on-one table work. The session also may consist of working the small intrinsic muscles of the hands, wrist, or lower leg — or working on the large muscles of the spine, hips, and quadriceps. Every movement is intentional and tailored to reaching each client's individualized goals. The goal is to achieve neural plasticity through neuromuscular re-education by way of reactivation and reorganization of the nervous system. This approach considers very mindful hands-on manipulation performed on the client with closed kinetic chain exercises that focus on creating the appropriate biofeedback to the brain through repetitive therapies. PNAR techniques are used in this portion of training extensively.

This is followed by a personal training session that may last from 45 minutes to an hour depending on what types of exercises, equipment, and modalities are being utilized during the session. The latter portion of this session focuses on strength and mobility. The TPS staff uses cutting edge technology such as the G-EO pictured in Figure 3. This gait training technology suspends a patient from a harness while robotics moves the patient's legs through a walking motion. The machine can be adjusted to support varying amounts of body weight depending on each client's abilities. It can assist clients with anywhere from just the initiation of the movement to the entire motion; it can even be programmed to help the client complete the motion after waiting for the client to initiate a certain percentage of the effort required for the forward motion of walking. This completely customizable modality strengthens the muscles in the legs and helps the nervous system relearn motor skills through repetitive movement (8).

Interventions such as the G-EO and other exercise-based therapies not only positively impact clients with their prognosis after SCI, but also decrease the likelihood of numerous secondary complications after injury. Literature has been discussing the effects of posture and exercise (like the methods utilized at TPS) on improving cardiovascular complications, respiratory complications, urinary and bowel complications, spasticity, pressure ulcers, osteoporosis, and bone fractures for many years (9). A study by Harkema et al. in 2010 investigated the effects of active standing training on cardiovascular health in patients with SCI and determined that even patients with complete cervical SCI injuries showed improvement in resting arterial blood pressure

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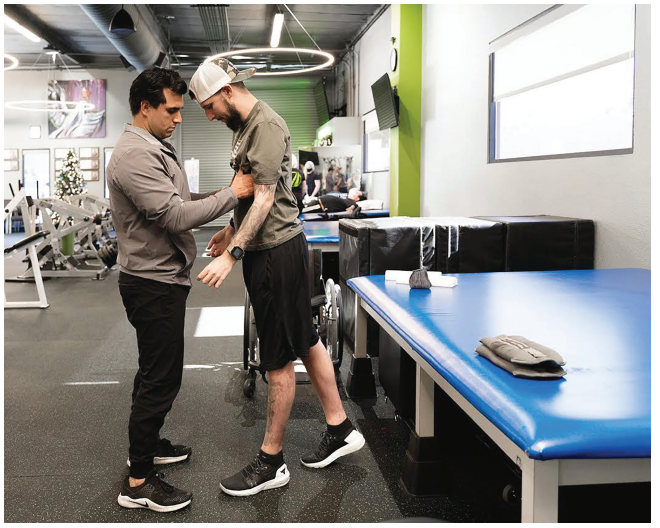
Figure 2. Perfect Step Specialist working with a client engaging in stability, gait, and balance activities as a part of their session. Photo courtesy of The Perfect Step.



and orthostatic stress after the repetitive neuromuscular activation of the legs from loading and/or the cardiovascular conditioning achieved by repetitively assuming an upright posture (10). Upright posture and relatively high intensity training (70% to 80% of maximum heart rate) also improves respiratory function, though the ideal training regimes have not yet been identified and which research with TPS could shed light upon in future studies (11). Furthermore, Sadeghi et al. reported a trend toward decreased spasticity after dynamic standing training in individuals with SCI though their results were not conclusive (12). This could be attributed to the very long-term nature of recovery, which does not provide drastic improvements in short periods of time such as those assessed in their study (two sessions two days apart); however, this does lend itself to more long-term and follow-up studies that would continue to be able to assess the effects of standing over time (12).

By focusing on the approach of ABTs, looking holistically at the body, and working below the injury level, the STEP Method at TPS reinforces the mindset of "exercise is medicine" as it puts clients in a better state of health mentally and physically to combat the short- and long-term effects of their injury. The concept that exercise is medicine is not novel, yet it is often ignored. The Exercise is Medicine® (EIM) initiative was launched within ACSM in 2007 with the presidency of Robert E. Sallis, M.D., FACSM, and Bilchak et al. explained the synaptic and neural plasticity markers enhanced by exercise that allow for improved motor function after SCI in a study in 2021 (13). By testing for presynaptic markers, a postsynaptic scaffolding protein, and an indicator of glutamatergic synapses, it has been determined that repetitive exercises promote synaptic plasticity by either increasing formation or maintaining damaged synapses after injury. Findings of the study suggest that these neuronal populations may come from sensory afferent and interneurons, especially in a complete SCI, whereas incomplete may also utilize spared supraspinal pathways. Rehabilitation also has demonstrated an increase in perineuronal nets (PNNs), a molecule of the ECM found in lumbar nerves that is both protective and inhibitory to neural networks, which are associated with activity-dependent synaptic plasticity during development and after SCI, though the exact mechanisms are not well flushed out. Other molecules tested in this review were neurotrophins (growth factors that promote neurogenesis, neuroregulation, synaptic regeneration, neuroprotection, and neuronal survival), which have been shown to be regulated by exercise in animal models regardless of the exercise. Bilchak et al. continued by looking at what can be provided during exercise to further promote regeneration such as electrical stimulation, which seems essential to bypassing the lesion site of an SCI to reconnect these pathways in a patient (13).

By focusing on the approach of activity-based therapies, looking holistically at the body, and working below the injury level, the STEP Method at TPS reinforces the mindset of "exercise is medicine" as it puts clients in a better state of health mentally and physically to combat the short- and long-term effects of their injury or diagnosis.

One of the most powerful attributes of TPS is that there are several ways to keep persons engaged in the program for many

Figure 3. Clients at The Perfect Step can use "best fit" technology to fit their needs. Here, a client is using a G-EO System assistive walking machine as part of their training program. Photo courtesy of The Perfect Step.

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months. Although not yet realistic for all clients (especially those with complete and/or cervical spinal cord injuries), the goal of TPS is to motivate, encourage, and persist with clients to be able to mobilize without the use of assistive devices such as wheelchairs, AFOs, KFOs, arm crutches, walkers, canes, etc. The innovation coming from TPS will further best in-class programs in nutrition, precision wellness, and different types of exercise programs that may allow for a higher percentage of clients to reduce their reliance on assistive devices, increase their abilities to develop and reprogram their nervous system, and thus enhance their functionality. Results of the recent study conducted through TPS found that persons engaged in long-term programs saw 18% of participants (8 out of 49) did increase ambulatory status with the aid of walkers, canes, or braces (14). A long-term follow-up report is now ready for submission with former TPS clients from more than 10 years ago and current TPS clientele to see how they have responded to their treatments over time. The first report is completed, and we aspire to conduct future research that may impact the future of the Physical Medicine and Rehabilitation (PM&R) field by better understanding exercise as medicine and its crucial role in treatment of people with SCI.

CONCLUSIONS

TPS will continue to innovate with leadership from their management, training staff, and board. They have a vision to expand the reach of their programs to other medically based fitness centers by training professionals in advanced methods of working with SCI. Their facility licensing opportunity began in the spring of 2023. It is a big step forward for the fitness industry, and over time, a wider array of persons with SCI will be able to benefit from TPS's groundbreaking approach to SCI therapy to improve the lives of their clientele.

TPS represents two areas of clinical exercise that are moving the profession forward. First is the high level of education and clinical experience of their staff. Second, they deliver outcomes-based practices to all their training components. TPS is a program that any other chronic care fitness program should be modeled after. Their standard is high, and that is a very good thing for the health industry.

No matter the level or severity of the SCI, all patients can reap the rewards of ABT such as the sessions at TPS by decreasing their secondary complications, increasing their independence, and improving their quality of life. As this program evolves and their research programs develop, they may even be able to start evaluating their clients for synaptic plasticity markers and demonstrate that exercise is one of the most important types of medicine when recovering from a spinal cord injury.

Author contributions

Methodology — H.H., A.W.; Conceptualization — A.W., H. H.; Analysis — S.J.M., E.P.D.; Data curation — S.J.M., E.P. D.; Writing — original draft — S.J.M., E.P.D.; Writing — review and editing — S.J.M., E.P.D.

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Glossary and Definitions

ABT — activity-based therapy
ADL — activities of daily living
AFO — ankle foot orthosis
ALS — amyotrophic lateral sclerosis
ACSM — American College of Sports Medicine
AIS — ASIA Impairment Scale
ASIA — American Spinal Cord Injury Association
ECM — extracellular matrix
EIM — exercise is medicine
FMA — Functional Movement Assessment
ISNCSCI — International standards for neurological classification of spinal cord injury
KFO — knee foot orthosis
MS — multiple sclerosis
PNN — perineuronal nets
PNAR — patterned neural activity recruitment
PW — Project Walk
RCT — randomized control trial
SCI — spinal cord injury
STEP — special techniques and exercises for paraplegia
Tetraplegia — paralysis affects the upper and lower limbs
TPS — The Perfect Step
TBI — traumatic brain injury

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BRIDGING THE GAP

The Perfect Step is the premiere program integrating functional training with patients who have suffered from spinal cord injury. TPS has the potential to redefine the rehabilitation research field and expand the growing consideration of exercise as medicine because of their novel research program and specialized personal trainers' methodologies. The programs range from using specialized assessments (such as the Functional Movement Assessment) to specific neural movement patterns designed to enhance synaptic plasticity of nerve and muscle cells. This increases their clients' ability to walk and enhances their overall quality of life, improving activities for daily living and decreasing secondary complications. This literature review assesses research methodologies developed at TPS that warrant further investigation and aims to suggest ways to further research in rehabilitation for patients with SCI in ethical, effective, and scientific manners.

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